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ARTICLE III.

THE STALEY'S CREEK AND NICK'S CREEK IRON ORE REGION.

BY BENJAMIN SMITH LYMAN.

WITH A MAP.

(Read before the American Philosophical Society, Oct. 4, 1872.)

The Staley's Creek and Nick's Creek Iron Region, near Marion, Smyth County, Virginia; according to a Rough Survey made in 1866 by Benjamin Smith Lyman.

Situation,	Thomas Ore Bed.
Lay of the Land.	Cole Ore Bed.
Geology.	Mode of Occurrence.
Structure.	Yield.
Rocks.	Wood.
Old Mountain Ore Bed.	Iron Works.
Corbet Ore Bed.	Map.

SITUATION.

The Staley's Creek and Nick's Creek Iron Region (counting in it the whole of the Thomas 5,000 acre tract and the Campbell Main Tract, parts of which are strictly not upon the waters of those creeks) lies in the form nearly of a parallelogram about two miles and a-half wide from north-northwest to south-southeast and about nine miles long from east-northeast to west-southwest, containing about twenty-two square miles and a-half, or 14,300 acres; with the northwestern corner of the parallelogram about two miles south of the village of Marion, Smyth County, southwestern Virginia. Marion is on the Virginia and Tennessee Railroad, 160 miles from Lynchburg and 174 miles from Knoxville. The region contains, besides the Thomas tract of 5,000 acres at the western end: east of that, the G. H. Williams (400 acre) tract and a ninety acre tract claimed by A. H. Campbell to lie north of G. H. William's tract between it and the eastern part of the Thomas tract; still east of these tracts the Crockett 1141 acre tract on the north, the S. M. Williams 400 acre tract and the

Marchant 725 acre tract on the south; east of these, the Campbell 147 acre tract on the north, the Campbell 4 acre tract in the middle and the Henderlite 1200 acre tract on the south; east of this last, the Wright 600 acre tract; and easternmost of all, the Campbell main tract of 3550 acres. There are besides within the region a part or the whole of a Nichols tract south of G. H. Williams and some land northeast of the Campbell 147 acre tract.

LAY OF THE LAND.

The southern boundary of the parallelogram would be at the top of Brushy Mountain, for the most part about a thousand feet high above the lowest level (in this region) of the waters of Staley's Creek. About a mile and a quarter north of this mountain runs parallel to it through the whole length of the region a range of nearly the same height cut into three parts by the cross gaps of Staley's and Nick's Creeks; the western part is called Pond Mountain, from a pond somewhere upon it, and the two other parts are called Chestnut Mountain; but as this last name is also sometimes given to the western part of Brushy Mountain and gives rise to confusion, it would be convenient to drop it altogether. The Staley's Creek gap is at about the middle of the range, and the Nick's Creek gap at about the middle of the eastern half. Both creeks fork near the upper (southeast) end of the gaps, and their forks extend in either direction east and west on the north side of Brushy Mountain. The West Fork of Staley's Creek is something over three miles long, heads near the western limits of the region, and has to the south of its head a small mountain called Minton's Ridge between it and Brushy Mountain. The East Fork of Staley's Creek is a little over two miles long; and one of its branches is separated only by a low divide from the West Fork of Nick's Creek, which is but about half a mile long. The East Fork of Nick's Creek is perhaps something more than a mile long. Nick's Creek flows northerly through the gap towards the Middle Fork of Holston River, and Staley's Creek flows into the same river at Marion by a northwesterly course after leaving its gap in Pond Mountain. North of the Pond Mountain Range are smaller parallel hills or mountains, amongst which on the north some of the waters of Staley's Creek take their rise; while in the northeast they are drained by two small streams that run northerly across the northern boundary of the Campbell main tract. The South Fork of the Holston River flows westerly past the southwestern corner of the parallelogram; and between it and Minton's Ridge is another small parallel ridge called Cave Ridge separated from Brushy Mountain by a small valley called Rocky Hollow. South of the river, at the southwestern corner of the Thomas' tract, is still another small parallel mountain called Stone House

Mountain. Staley's Creek where it enters Marion is about two thousand feet above the sea.

GEOLOGY—STRUCTURE.

The rocks of the Pond Mountain Range lie in saddle form, and the saddle appears to sink towards the east from the highest part of the mountain, near the western end of the Iron Region. At the Nick's Creek Gap a small basin may be perceived upon the top of the saddle, and the small southern saddle of the basin may rise eastward so as to replace the other that is sinking; or on the other hand this southern saddle may be only a small roll that soon dies out eastward as well as westward. The rocks of Brushy Mountain form in like manner a saddle, but it appears to have at the westernmost end of the region a double crest, the northern part being the larger; but the southern part seems to rise eastward and to unite with the northern before reaching the eastern end of the region; that is, the small basin at the top of the saddle disappears eastward. There are probably more saddles than one just north of Pond Mountain. Between the Pond Mountain and Brushy Mountain saddles the rocks lie in basin form of course; and there is another basin just north of Pond Mountain.

The dips of the Brushy Mountain saddle are, in the western half of the region, forty-five degrees southerly on the south, and sixty to eighty or even ninety degrees northerly on the north; and appear to grow rather less steep towards the east on the north side, and to steepen in that direction on the south side. The dips of the Pond Mountain saddle are forty-five degrees on either side at Nick's Creek, but steeper westward, especially on the northern side, so as to become in the Thomas tract seventy degrees southerly, reversed.

ROCKS.

The rocks of the region are almost wholly sandrocks and shales; and seem to belong wholly or chiefly to the Formation called in Pennsylvania and Virginia No. I, corresponding to the lower part of the Lower Silurian System. They are grey at the bottom, brown in the middle and red at the top. On the top of Brushy Mountain, near the southwest corner of the Henderlite tract, near the middle of the saddle and consequently among the lowest rocks exposed in the region, are cliffs of a pudding rock made up of rounded pebbles as large as peas and smaller, of white and rosy translucent quartz, apparently in part if not wholly water-worn crystals. Just north of the region and just south of it the blue lime rock of Formation II (also Lower Silurian) appears; and it is likewise found in smaller patches within the region in the middle of some of the basins, probably in all the deep portions of the basins. Between the layers of the lime rock, at least near the bottom, appear to be layers of brown sand rock.

There seem to be outcropping in the region at least 3,000 feet, and perhaps 4,500 feet in thickness of the sandrocks and shales, and in the third basin north of Pond Mountain some fifty feet of the lime rock No. II. There are numerous openings and natural exposures of the outcrops of iron ores, but they seem all to belong to four beds.

The Day Ore Bed appears to lie about 600 feet below the lowest lime rock.

The Thomas Ore Bed lies about 700 feet below the Day Ore Bed.

The Cole Ore Bed is about 1300 feet below the Thomas Ore Bed.

The Old Mountain Ore Bed is about 400 feet below the Cole Ore Bed.

From that to the lowest rocks cropping out where the top of the Pond Mountain crosses the west line of the Thomas tract is perhaps 1500 feet.

The ore of all the beds is brown hematite.

OLD MOUNTAIN ORE BED.

The Old Mountain Ore Bed seems not to be opened anywhere strictly within the region, but is opened at the Old Mountain Ore Bank, close to the southeast corner of the Wright tract, but on the south side of Brushy Mountain, at the top of its southern saddle, at the divide between Slemph's Creek on the east and George's Creek on the West. At this bank there are two large openings, one, the old one, long since abandoned, and the other still in use and the larger; and besides them there are three smaller ones. The thickness of the bed is not apparent, but it must be several feet, perhaps ten feet, possibly more. It furnishes the favorite ore for bloomary forge use of all the region round, and is said to make a very tough iron of the best quality, neither too hard nor too soft, barshire. The ore is a very beautiful, pure looking, honey-combed but pretty compact brown hematite. At one of the smaller openings, the ore is of a dark bluish color and is more compact, but looks pure; it is said to make "exceedingly tough iron in the bloomary, but to free itself less easily than the other one from cinder. It works finely when mixed with the other ore, but as it was a little difficult to hit just the right proportion in mixing, the blue ore was wholly abandoned." The main opening is some twenty yards across and is fifteen to twenty-five feet deep according to the slope of the ground.

The same bed, apparently, is opened at the Barton Ore Bank, about a mile further west on the same outcrop, and about a quarter of a mile east of the southwest corner of the Henderlite tract. The opening is on the south side of a small hollow near the top of Brushy Mountain, and is some forty yards wide and ten yards deep at the western end. The bed seems to dip forty-five degrees northwesterly and is said to have shown that dip much more plainly before the sides of the hole had fallen in so

much as they had in 1866 after having been abandoned five or six years. The ore is stated to have been "a bed about four feet thick, of very good quality in the bloom-ary forge, very easily melted and making very excellent tough substantial iron; but not always perfect, probably red-short, for wagon tires were sometimes ruined while making." The good ore is a beautiful compact brown hematite that looks very pure; but the rock left unmined just below the ore bed is a pudding rock of white crystalline rounded quartz pebbles smaller than peas, united by a brown hematite cement, making also an iron ore but of inferior quality.

The outcrop of the bed is shown also at several places in the region by beds of ore; on the road across Brushy Mountain at the west end of the Henderlite tract, near the top of the mountain, and on the bridle path across Pond Mountain on both sides of the mountain near the top; so that the bed seems to be persistent over a wide space, although the thickness is not known.

The bed seems either to crop out or to come very near the surface all along the top of Brushy Mountain, and to have in all seven miles in length of outcrop in this part of the region. On the south side of the Pond Mountain saddle its outcrop runs from the western edge of the Thomas tract three miles and a quarter nearly across the tract; and then the same outcrop returns westward, on the north side of the saddle, about three miles to the western boundary again, making for the whole Pond Mountain outcrop six miles and a quarter, everywhere near the top of the mountain. North of that the bed seems not to come to the surface again anywhere. The whole length of the outcrop of the bed in the whole region seems then to be about thirteen miles and a quarter.

The amount of ore in tons above the lowest water level of the region has been calculated for one foot of average thickness of pure ore. The lowest water level of the region is taken to be at about a hundred feet above the level of the Staley's Creek where it enters Marion, and is about the lowest level of the waters of that creek where they leave the Thomas tract. These numbers of tons will have to be multiplied of course by the number of feet that the bed averages in thickness, whatever that may hereafter prove to be. In the Brushy Mountain part of the bed there seem then to be above this water level for each foot of average thickness of the bed 7,110,000 tons; in the Pond Mountain part of the bed in like manner 2,380,000 tons; in all therefore 9,490,000 tons for each foot of average thickness of the bed.

As for the average thickness of pure ore in the bed in feet (the multiplier of this number for the full amount of ore) the imperfect information as to the thickness of the bed at the Old Mountain Ore Bank and at the Barton Ore Bank would go to

show an average thickness of something like seven feet. The outcrop lumps scattered on Brushy Mountain and on Pond Mountain show the persistence of the bed but give no clue to its thickness.

COLE ORE BED.

The Cole Ore Bed has been opened apparently at two places in the region, both on the Thomas tract, and very insufficiently at both, at least for present observation (1866). The oldest opening on the bed, the Cole Ore Bank, on Rocky Branch, near the head of the hollow, was made about the year 1820, and afterwards its ore was used at Nichols' Forge; but the bank was abandoned some sixteen or eighteen years later, and there is no longer even any hole there, and it must have been but a small hole at any time. It is no longer known whether the solid bed was opened or only the loose lumps at the outcrop. Judging by a few small lumps of ore that still lie about the old opening the ore (brown hematite) was very rich.

At the other opening on the bed, the Pine Spur Ore Bank, on the eastern side of Pine Spur, near the northwest corner of the Thomas tract, a small hole now all fallen in was once dug, and lumps of the ore were found, but not the solid bed. To judge by the little left exposed there the ore is a good deal mixed with angular bits of compact brown sandstone. It is barely possible that, in consequence of a sinking westward (as well as eastward) of the Pond Mountain saddle from a high point near the middle of the Thomas tract, the ore of the Pine spur bank may belong to the Thomas Ore Bed.

Bits of the Cole ore are also found on the hillsides about a quarter of a mile east of Pine Spur opening; and on the bridle path already mentioned near the top of Pond Mountain, on both sides of the summit; on the northern side only a few small bits, but on the southern side (where the water gullies have exposed it better) the blocks are abundant and the quality of some of them pretty good, although another portion of them are merely brown sandstone sprinkled with the ore. It would be easy and well worth while to make an opening here that would thoroughly test the value of the bed at this point; a self-draining drift or open cut could be made north-westward so as to lay bare the whole thickness of the bed. The blocks here are washed for some little distance down the mountain along the path. Outcrop lumps apparently from this bed are found also even so far away as on the road across Brushy Mountain, near the southwestern corner of the Henderlite tracts three miles and a quarter east of the Cole ore bank.

The outcrop of the bed within the region seems to run for four miles and a-half on the south side of the Brushy Mountain saddle and for nine miles and a quarter on the north side, making fourteen miles and a quarter in all for the Brushy Mountain

outcrop. The outcrop south of the Pond Mountain Saddle seems to run from the western edge of the Thomas tract four miles and a quarter easterly; then to return westerly four miles; making for the whole length of the Pond Mountain outcrop a length of eight miles and a quarter. North of that the bed appears not to rise anywhere to the surface; so that the whole length of its outcrop within the region is twenty-two miles and a half. It may seem useless perhaps to reckon the outcrop so long when the bed has not been opened nor even its outcrop observed through a great part of it, especially at its eastern end; but the measurement serves to show at least through what space it is worth while to search for the outcrop, although it is possible that the bed may have thinned out and disappeared in some parts. On the other hand it may have become enough thicker in the other parts to make up for any such thinning out.

The amount of ore in tons above the lowest water level of the region has been calculated for one foot of average thickness of pure ore in the same manner as for the Old Mountain Ore bed, and gives: in the Brushy Mountain part of the bed, on the south side 4,150,000 tons; in all 5,710,000 tons. In the Pond Mountain part of the bed is found in like manner 2,660,000 tons. The whole amount of both parts of the bed is then 8,370,000 tons per foot of average thickness.

The average thickness of the bed in feet (the multiplier of these numbers of tons to get the full amount of ore in the bed in this region above water level) is quite unknown; but from the appearance of the outcrop on the bridle path, as the southern side of the Pond Mountain, the bed would seem to have at least a couple of feet in thickness of good, rich ore.

THOMAS ORE BED.

The Thomas ore bed has apparently been opened at several points in the region. The largest and best opening of all is the Thomas ore bank on the Thomas tract, on the Ore Knob, a small spur of the north side of Pond Mountain, about a mile and a quarter east of the northwestern corner of the tract and of the region. The opening is an open cut some ten feet wide running southeasterly about thirty yards, apparently almost at right angles with the strike; and there is from the northern end of the cutting a similar cutting about as long running a little west of south. The ore is exposed in the sides of these cuttings some ten feet in thickness in two or three solid layers, and lies nearly flat, with the appearance of being at the gently rounded top of a saddle; but it is probably only a small saddle or roll upon the northern side of the great saddle of Pond Mountain. The ore is also said to extend below the bottom of the cutting and to be covered up there with rubbish, but it looks in the centre of the saddle as if the ten feet were the full thickness of the ore, and as if there were clay

or something soft below it. The ore is very compact brown hematite, full of angular grains of white translucent quartz of the size of peas and smaller, so numerous as to reduce the iron contained in the unwashed ore, perhaps to thirty-five per cent or thereabouts.

About 350 yards east of the Thomas bank is the Hardbarger ore bank on the same bed apparently. It is a hole about fifteen feet deep and thirty feet wide, east and west, on the side of a hill, exposing a large surface of the ore at the northern end of the hole; but the dip cannot be easily made out. The ledge of ore (brown hematite) is broken by cracks in every direction into lumps that are often as much as two or three feet thick, and all the ore is full of angular bits of fine grained buff sandstone, making a breccia of it. It is said that some of it was used for making iron in the blast furnace, and after washing made as good iron as the ore from any of the other banks of the Thomas tract, contrary to expectation. It is quite likely that the ore taken from here came only from the top of the bed, or from the bottom of it, and that a more thorough exploration by digging across the whole thickness of it, would bring to light ore more like that of the Thomas ore bank. The surface of the ore now exposed is about parallel to the course of the bed, so that nothing can be determined from it as to the real thickness of the bed.

This bed apparently is opened also at the Roan ore bank at the roan tree corner of G. H. Williams' land, only about a quarter of a mile east of the eastern boundary of the Thomas tract, on the northern slope of the Wolf Pen Ridge (a spur on the north side of Brushy Mountain), and opposite the eastern end of Minton's Ridge. The opening is but a small hole, a yard or two across and about a yard deep, opened long ago and long since abandoned and fallen in; and there is no evidence whether the solid ore bed was struck, but it is likely that only the loose lumps near the outcrop were found. They are still to be seen scattered about on the hillside around the opening, and show that the ore is a compact brown hematite; but some of it (perhaps all) is filled with small white translucent quartz grains like the ore of the Thomas bank, except that the grains here seem to be all nearly as small as a pin's head; and the richness of the ore seems to be about the same as at the Thomas bank. There is of course no clue to the thickness of the bed.

The same bed too seems to be opened imperfectly on the Henderlite tract by three small holes about forty yards apart, from which only loose, outcrop lumps were taken, at the north side of Brushy Mountain, a hundred yards east of the road at the western boundary of the tract, and three quarters of a mile south southeast of the forks of Staley's Creek. At the two lower openings the ore is a fine honeycombed

brown hematite, apparently very pure; but at the upper hole corresponding to the bottom of the bed, the ore is more silicious from the presence in it of small, round grains of crystalline quartz a little bigger than a large pin's head.

The bed seems to be opened also on the Wright tract at the Key's ore bank; likewise on the north side of the Brushy Mountain Saddle, nearly half a mile north-northwest of the southwestern corner of the tract, near the burnt ruins of an old cabin called Key's Cabin. It is but a very small trial opening, and the ore, found only in loose lumps, is brown hematite in seams running through a brown, fine grained sand-rock making a breccia of it; and it was found too sandy for use in the bloomery. But it is quite likely that a more thorough digging would bring better ore to light here, as at the other opening of the bed already mentioned.

The presence of the bed is also shown by lumps of ore on the ground for more than a hundred yards, at least, west of the Thomas ore bank (the largest lump must weigh at least 300 tons); and again at a point a quarter of a mile west southwest of that bank; and at the bridle path across Pond Mountain, about half way down the northern slope of the mountain and near the foot of the southern slope. At this last place the ore lumps are very numerous, and a little piece of them has been gathered together from a small space; and the ore seems to be of a very good quality. At the outcrop in the bridle path on the north side of the mountain the lumps are also very numerous and those on the downhill side of the outcrop, corresponding to the upper side of the bed (here reversed) are mere lumps of sandstone with veins of hematite running through them, something like the Hardbarger ore, but poorer. At all these natural exposures of lumps from the outcrops, of course, the lumps roll and slide and get washed to a greater or less distance down the hill; but the position of the outcrop can be told more or less exactly by the upper limit of the ore lumps, since they are not carried up hill.

The outcrop of the bed along the southern side of the Brushy Mountain Saddle seems to run for about a mile, across the southeastern corner of the Thomas Tract close by the southern boundary; and on the northern side of the saddle for nine miles and a quarter; making ten miles and a quarter in all. The outcrop south of the Pond Mountain Saddle seems to run from the western line of the Thomas tract five miles and three-quarters easterly, then to return westerly on the north side of the saddle five miles to the same line; making ten miles and three-quarters for the whole Pond Mountain outcrop. The bed seems to come to the surface again nowhere north of that in the region; so that its whole length of outcrop here amounts then to twenty-one miles.

Calculations of the amount of ore in tons above the lowest water level of the region for one foot of average thickness of the bed, like these made for the preceding beds, give: for the Brushy Mountain part of the bed 3,330,000 tons; for the Pond Mountain part, 1,590,000 tons; in all, then, 8,020,000 tons per foot of bed.

The Thomas Bank would indicate a thickness of ten feet at least for the bed (requiring these numbers of tons to be multiplied all by ten to get the full amount of ore in the bed above water level, with a deduction on account of the quartz in the ore); and it is the only point where anything like the full thickness of the bed can be seen. At the other points mentioned where the loose lumps of the outcrop have been found on the ground or dug up, the abundance of the lumps is quite consistent with such a thickness of the bed; but in the absence of any thorough trial pits it is impossible to tell what the thickness may be at those points. In order to form an idea of the average thickness of the bed throughout the region, a number of trial pits should, of course, be sunk along the different outcrops so as to expose the full thickness of the solid bed.

DAY ORE BED.

The Day Ore Bed also seems to have been opened at several points within the region. The largest opening is the Day Ore Bank on the Thomas Tract about a mile northeast of the Thomas Tract. That bank supplied Day's Forge, it is said, on the South Fork of Holston River, between the years 1790 and 1824, and after that Nichols' Forge, further up the same river. The ore has been dug from the outcrop up along the side of the hill by an open cut a hundred yards long and about twenty feet wide and fifteen feet deep. At the lower end of the cutting the lumps of ore, from three feet in diameter down, form a layer about a foot and a half thick, some three feet below the grass on the northwest (up hill) side of the cutting, and are still more abundant on the lower side. At the upper end of the cutting the solid, nearly vertical bed of ore is exposed in part, and measures ten feet in thickness, but the southeastern surface is indistinct from its being broken up into lumps. The ore is a beautiful brown hematite, very compact, yet containing many very small cavities; but it appears silicious, and in the cavities are small quartz crystals or chalcedony, and many parts of the ore seem to have fine sand intimately mixed with it; and it is said that on first working the bank there was a good deal of quartz in the shape of small round pebbles mixed with the ore.

This seems also to be the bed opened at the ore bank in the Flat, on the Thomas Tract, about two-thirds of a mile southwest of the Day Ore Bank. The opening is a hole about fifty yards long, northeast and southwest, and fifteen yards wide and

perhaps six yards deep, in a flat piece of ground, and was in 1866 so full of water as to hide the ore. The solid ore bed is said to have been worked here and to have been followed as it dipped southwards, and to have been ten or twelve feet thick. This is reckoned the best of the ore banks on the Thomas Tract, at least for the quality of the ore; and judging from a few lumps lying about the bank it is really a very beautiful honeycombed brown hematite, not entirely free however from silicious matter in the form of chalcedony.

The same bed, as it seems, is opened at the Williams Ore Bank on the G. H. Williams Tract, on the other (southern) side of the Pond Mountain Saddle, about 600 yards east of the Thomas Tract, and near the northern side of the West Fork of Staley's Creek, at the foot of the Pond Mountain. The bank consists of two old holes a couple of yards in diameter and about as deep in the side of the hill; and it would seem that the solid bed was not found here, but only the loose lumps near the outcrop. Judging by the lumps still lying about the bank the ore is a very compact brown hematite, inferior to the ore of the ore bank in the Flat, but still quite good.

The same bed apparently is opened 350 yards southeast of the Williams Bank on the other side of the basin and of the valley, near the foot of the northern slope of the Wolf Pen Ridge, at the Nichols Ore Bank. This is likewise only a small hole in the ground, where probably only the loose lumps of the outcrop were found, and it has been abandoned for fifteen or sixteen years. The lumps still lying about it show the ore to have been a very beautiful compact brown hematite, apparently of the greatest purity.

A quarter of a mile northwest of this on the same hillside is a large opening, long since abandoned, that seems to be on the same bed, and is called the Old Staley's Creek Ore Bank. Only lumps of ore appear to have been found here, and the real outcrop of the bed is probably a little higher up hill. The lumps of ore still lying about show that it is a very fine compact brown hematite, apparently of excellent quality.

A quarter of a mile still further west along the same hillside is the Main Staley's Creek Ore Bank, on the same bed, a large opening fifty yards long, east and west, and thirty yards wide and ten yards deep on the deepest side towards the south. It is said that the solid ore bed was worked here, but the digging has been abandoned for some time, and is so fallen in as to hide the ledge. There are, however, two large six foot blocks together here and a third partially uncovered in another part of the hole, and some of them may be still in place. The ore is a very good brown hematite, but not perfectly free from silicious matter.

This bed seems also to be the one opened at the Nick's Ore Bank on the Camp-

bell Main Tract, on the steep hillside about three hundred yards southeast of the forks of Nick's Creek, and about a hundred yards southwest of the East Fork of that Creek. The loose lumps that had slid down the hill from the outcrop of the bed were traced by small holes until the bed itself (it was thought) was opened by a small digging high up the hill; but the bed does not seem to have been explored thoroughly as to thickness, and the hole is now fallen in. The ore is brown hematite of very fine quality, and is so pure in parts as to have the fibrous form, and other parts are compact.

This seems to be also the bed that is opened at the West Ore Bank on the south side of Store House Mountain, about a quarter of a mile south of the southern line of the Thomas Tract and three-quarters of a mile southwest of the point where the South Fork of Holston River crosses that line. The solid bed seems not to have been opened here, but only the loose lumps of the outcrop, and the small hole that was dug is fallen in. The ore lumps still scattered about the hole are of beautiful finely honeycombed brown hematite, apparently of the best quality.

Besides all these openings, the bed shows itself by bits of ore on the ground in the bridle-path across Pond Mountain, near the northern foot of the mountain; and also in the old road across Brushy Mountain, some five hundred yards due south of the forks of Staley's Creek; and loose lumps of ore apparently from the outcrop of this bed are to be seen on the hillside west of Nick's Creek, some six hundred yards southeast of the northwest corner of the Campbell Main Tract.

The outcrop of the bed, on the north side of the Brushy Mountain Saddle, seems to run from the east side of the Campbell Main Tract westerly eight miles and three quarters; then to return eastward along the south side of the Pond Mountain Saddle seven miles and a quarter; then to run westward again on the north side of the Pond Mountain Saddle seven miles and a quarter; also on the south side of the next saddle to the north it seems to run for two miles and a half, and as much more on the north side; making in all twenty-six miles and a half for the length of the theoretical outcrop. As the ore has not been found east or west of the Thomas Tract along the last mentioned small saddle, it is quite likely that the saddle so sinks eastward, and rises so slowly towards the high ground westward that the ore does not come to the surface outside of the tract, except for a short distance on the west. It should also be mentioned that, although a former owner of the Crockett Tract made diligent search for iron ore (without any system to be sure), none of any persistence or on any of these outcrops was found; so that these beds of ore may, in that portion of them, have thinned out possibly to insignificance.

The amount in tons for one foot of average thickness of the ore of the bed above

the lowest water level of the region, has been calculated as for the aforementioned beds, and is: On the north side of the Brushy Mountain Saddle 2,840,000 tons; on the south side of the Pond Mountain Saddle 3,990,000 tons; on the north side of the same 3,050,000 tons; on the little saddle next to the north 930,000 tons; making in all, 10,810,000 tons for every average foot of bed.

The bed may be taken, from the exposures of it that have been described, to be pretty uniformly of good thickness and of fine quality throughout the region. It is impossible to state, however, without more thorough trial pits, what that thickness is in feet on the average, and what consequently should be the multiplier of the number of tons just given, to get the full amount of ore in the bed above water level; but it would seem to be perhaps ten feet, to judge by the best exposures alone.

ALL FOUR ORE BEDS.—*Mode of Occurrence.*

The mode of occurrence of these ores has already been discussed in a paper read at the Burlington meeting of the American Association for the Advancement of Science, 1867, vol. xvi., p. 114. Three parallel cross-sections show that the thirty or more ore banks and natural exposures occur at corresponding distances on the opposite sides of the Pond Mountain Saddle and of the basin south of it, as if they were the outcrops of four beds of ore conformable to the other rocks. At three or four of the ore banks the solid beds are to be seen, but at the other exposures the ore is in solid lumps of irregular shape and of every weight up to three hundred tons or more, scattered irregularly through brown gravelly loam. The ore (all brown hematite) is sometimes very pure, but often has in it rounded or angular grains or pebbles of white quartz, and sometimes is merely a cement that binds together angular pieces of light brown sandstone.

The deposits of loose lumps in this region seem to resemble in every respect those that are so common throughout the Great Valley of Virginia, and its prolongation northeastward as well as southwestward. They seem beyond a doubt to be the broken pieces from the outcrops of solid beds of ore and of the same character as accumulations of outcrop blocks of any bed of rock or the black dirt of a coal outcrop, or alluvial deposits of gold or tin ore, due regard had to the effect of the special hardness, bulk and weight of the iron ore. They do not by any means seem to come, as has been maintained, from the mere percolation of water through slates impregnated with iron, which is dissolved and carried into the loam and afterwards segregated in a remarkably perfect way.

Of course, the strength of the argument furnished by the ores of the region, depends partly on the exactness of the survey; but although this was only rough, the

limits of error in each cross-section are so small, compared with the distances apart of the different beds, that in a similar case the identity of coal beds exposed at different points would be quite undoubted; and the uniformity of those distances over a space of several miles is even surprising. The correspondence of the beds in the different cross-sections is, however, in some parts a little less certain. In a section across Pond Mountain and Brushy Mountain near the road the outcrop of the four beds are exposed on each side of the northern saddle, and probably the three upper ones are exposed on the north side of the southern saddle. In a section past the forks of Staley's Creek, the three lower beds seem to be exposed on the north side of the southern saddle; and in a section past the forks of Nick's Creek the upper and lower beds seem to be exposed also on the north side of the southern saddle. The exposures marked in the sections are almost all very near to the section lines, so that there can be no appreciable error from any possible slight mistake in the direction of the strike in projecting the exposures upon the section lines; and with a very few small allowances for slipping of the observed ore lumps down hill from the true outcrop of the beds all the known exposures correspond well with the theoretical outcrops of the four beds.

YIELD.—Taking the outcrops of all four beds together, there seem to be eighty-three miles of outcrop in the region.

In like manner the foregoing estimates give, for all four beds for the amount of ore in tons above the lowest water level of the region for one foot of average thickness of each bed, 36,690,000 tons.

The average thickness in feet of each of the four beds, taking them all together (the multiplier of that number of tons to get the full amount of iron ore in the region above water level), it is, of course, quite as impossible to state, as it is that of the least explored of the beds. Yet the exposures that have been described would go to show an average thickness of each bed of something like seven feet. That thickness would give according to the foregoing calculations over 250,000,000 tons of iron ore in the region above water level.

WOOD.—Within the region there seemed to be in 1866 about 260 acres of cleared land and 14,040 acres of woodland. The woodland of the Thomas Tract was estimated to bear on the average forty cords of wood to the acre, almost all hard wood; and the rest of the woodland of the region would probably yield as much.

A charcoal pit of twenty-five cords of wood; there, is reckoned to yield, when green, 800 bushels of charcoal; when dry, 1000 bushels. Charcoal at Marion cost in 1866 (it is said) from seven to eight cents a bushel. Just south of the region on Iron Mountain and southeast of that, are many thousand acres of woodland, and so

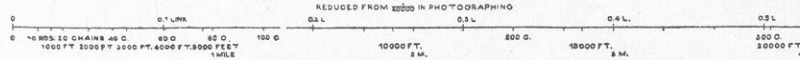
there are on the south side of Brushy Mountain, or Rye Valley Mountain, south of the region, and so also east of the region; so that the surrounding country could yield an immense supply of charcoal.

IRON WORKS.—The Marion Furnace was, in 1866, the only blast furnace in the region, and stood at the northern corner of the Thomas Tract, on Staley's Creek. It was begun in 1860, and first blew in near the end of 1862. It was run by the rebel government, and made about five tons of iron in 1862, perhaps 300 tons in 1863 and 275 tons in 1864; or about 600 tons in all. On the 16th December, 1864, it was burned by Gen. Stoneman's raiders and the wood-work mostly destroyed, but the stack seemed in 1866 to be still in pretty good condition. It was about forty feet high, three feet across the tunnel head and ten feet across the boshes, with two engines, and furnished with hot-air pipes, though only cold-blast was used. There was also a cupola furnace alongside.

The Woodlawn Forge, on Staley's Creek near the middle of the Crockett Tract, was built in 1857 by Mr. John P. Wright, and is a bloomery just like the others so common southwestward in these mountains, with one fire and one hammer and water blast; and run like them, by fits and starts, with a very small yearly yield. Its ore came chiefly from the Old Mountain Ore Bank. Just south of the region, on the South Fork of Holston River, are two other such bloomeries, Nichols' and Barton's Forges.

MAP.—A photograph of the map was shown at the Burlington meeting, in 1867, in illustration of the paper already mentioned. Not only is the shape of the ground shown by twenty foot contour lines, but the position of the four ore beds is given by contour lines upon each of them 100 feet apart in level from the lowest water level upwards. The ore bed contour lines show at the same time the structure of the other beds of rock, the saddles and basins, the strike and the steepness of the dip.

SCALE: 50000 OF NATURE (= 5000 FEET TO AN INCH)



NOTE: THE BOUNDARIES OF THE THOMAS TRACT ARE COPIED FROM A PLOT FURNISHED BY MR. THOMAS; THOSE OF THE CAMPBELL MAIN TRACT FROM A CAREFUL OFFICIAL PLOT BY MR. CALL, COUNTY SURVEYOR; AND THE OTHER BOUNDARIES (HEAVY DOTTED LINES), WITH SOME PROBABLE CORRECTIONS, FROM A PLOT FURNISHED BY MR. CAMPBELL. THE WESTERN CAMPBELL TRACT IS DISPUTED, AND THE MARGHANT TRACT IS PERHAPS MISPLACED ON THE MAP. . . . THE NUMBERS SHOW THE HEIGHT IN FEET (BY ANEROID BAROMETER) ON THE SURFACE OF THE GROUND OF THE CURVED CONTOUR LINES ABOVE A LEVEL OF ABOUT 2000 FEET ABOVE THE SEA. THESE LINES AT A DISTANCE FROM THE NUMBERS ARE MERELY SKETCHED, AND WHERE FAR AWAY ALSO FROM THE ROADS LAID DOWN ARE PARTLY CONJECTURAL. . . . THE LONG MOSTLY STRAIGHT LINES SHOW THE PROBABLE POSITION AND STRIKE OF THAT PART OF THE ORE BEDS WHICH LIES ABOVE THE LEVEL OF THE 100 FOOT CONTOUR LINE, SAY THE LOWEST WATER LEVEL OF THE REGION, AND ARE 100 FEET APART IN LEVEL ON THE BEDS. . . . THE ORE BEDS AND THE PUDDING STONE, SAND STONES AND SANDY SHALES BETWEEN WHICH THEY LIE BELONG GEOLOGICALLY TO THE PENNSYLVANIA AND VIRGINIA FORMATION N^o 1. (LOWER SILURIAN), THE LIME STONE BEDS ABOVE WITH SOME SAND STONE LAYERS BETWEEN ARE AT THE BOTTOM OF N^o 11. (ALSO LOWER SILURIAN). . . . THE ORE IS ALL BROWN HEMATITE; IT CONTAINS, THEREFORE, WHEN PURE, SIXTY PER CENT. OF IRON. . . . THE AVERAGE THICKNESS OF THE ORE BEDS IS QUITE UNKNOWN. AT THE DAY ORE BANK THE BED IS AT LEAST TEN FEET THICK, SO IS THE BED AT THE THOMAS ORE BANK; AND AT THE OLD MOUNTAIN ORE BANK IT SEEMS THAT THE BED MUST BE QUITE AS THICK, BUT THE HIGH PART OF THE SAME BED AT THE BARTON ORE BANK IS SAID TO HAVE BEEN WHEN OPEN ABOUT FOUR FEET THICK. AT THE OTHER ORE BANKS ONLY THE LOOSE LUMPS OF THE OUTCROPS ARE TO BE SEEN, EXCEPT AN IMPERFECT EXPOSURE OF THE BED AT THE HARBARGER ORE BANK, BUT THE LUMPS ARE NUMEROUS AND SOMETIMES VERY LARGE, EVEN SIX FEET THROUGH AT THE STALEY'S GREEN MAIN ORE BANK. THESE FEW IMPERFECT MEASUREMENTS GO TOWARDS SHOWING AN AVERAGE OF SEVEN FEET OR MORE FOR EACH BED'S THICKNESS AND THE MULTIPLIER OF THE TON NUMBERS IN THE TABLE.

GEOLOGICAL AND TOPOGRAPHICAL MAP OF A ROUGH SURVEY OF THE STALEY'S CREEK AND NICK'S CREEK IRON REGION.

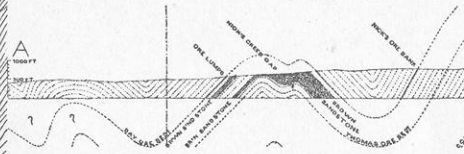
INCLUDING THE
THOMAS,
HENDERLITE,
WRIGHT, CAMPBELL,
AND OTHER
TRACTS.
NEAR MARION, SMYTH COUNTY, VIRGINIA.
BY BENJ. SMITH LYMAN, 135 SOUTH FIFTH ST., PHILADELPHIA.
5 JULY, 1867



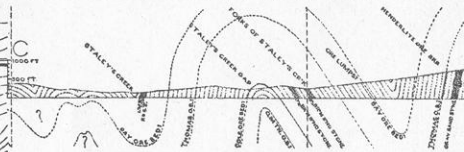
AMOUNT OF ORE ABOVE THE LOWEST LEVEL FOR EVERY FOOT OF AVERAGE ELEVATION

TRACT	TONS
THOMAS TRACT	1760
HENDERLITE "	1180
WRIGHT "	800
CAMPBELL MAIN TR.	4620
REST OF THE REGION	8360
TOTAL	10,510

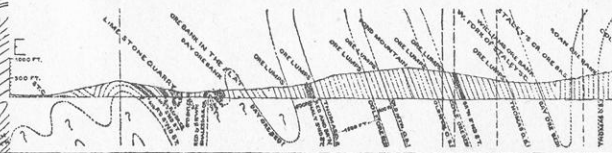
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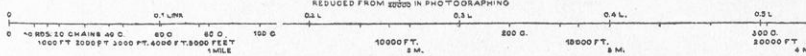
SECTION ACROSS THE



SECTION ACROSS THE SADDLE



SCALE: 60000 OF NATURE (= 5000 FEET TO AN INCH).



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EXTENT OF LAND

ACCORDING TO THE BEST INFORMATION.

THOMAS TRACT	AREA	ACRES
HENDERLITE	1550	480
WRIGHT	800	25
CAMPBELL	MAIN 3350	10
"	N. 2. 147	10
"	ARL 4	10
"	W. 50	10
REST OF THE REGION	10591	800

REST OF THE REGION:

CROCKETT TR.	1140	800
S. M. WILLIAMS	400	330
O. H.	400	280
MARCHANT	712	0
ELSEWHERE	1932	3700
	14291	800

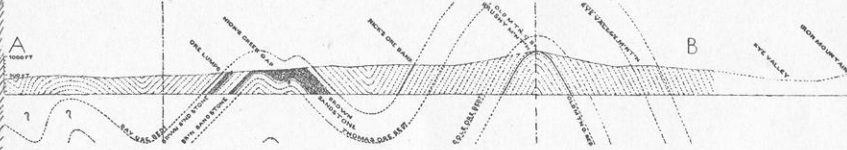
AMOUNT OF IRON ORE

ABOVE THE LOWEST WATER LEVEL OF THE REGION, AS SHOWN ON THE MAP, FOR EVERY FOOT OF AVERAGE THICKNESS OF EACH BED, ALSO LENGTH OF OUTCROPS.

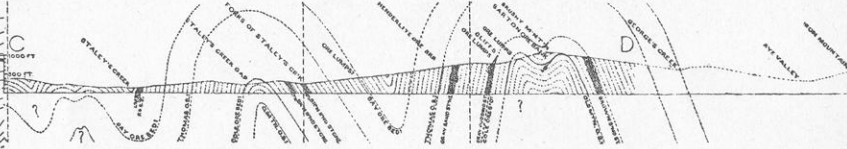
DAY ORE BED THOMAS 0.8 COAL ORE BED 0.8 MTN 0.8. ALL FOUR 0.8.

	TONS	MILES	TONS	MILES	TONS	MILES	TONS	MILES
THOMAS TRACT	1,760,000	84	2,100,000	74	3,330,000	11	3,490,000	74
HENDERLITE	1,180,000	3	1,220,000	24	460,000	1	440,000	03
WRIGHT	800,000	18	750,000	03	290,000	08	230,000	03
CAMPBELL MAIN TR.	4,620,000	5	1,710,000	3	1,670,000	33	1,900,000	23
REST OF THE REGION	8,360,000	174	5,760,000	134	5,970,000	154	6,080,000	98
	10,871,000	263	6,010,000	21	8,370,000	224	9,490,000	134

SECTION ACROSS THE SADDLES, IN THE LINE AB.



SECTION ACROSS THE SADDLES, IN THE LINE CD.



SECTION ACROSS THE SADDLES, IN THE LINE EF.

